

- GIDS-1: the GCIP Static Data System Test will make use of existing operational and experimental capabilities to provide data from the period 1 Feb-30 April 1992, which includes the STORM-FEST data period of 1 Feb-15 Mar 1992

- GIDS-2: an Initial Retrospective Data set consisting of operational data collected in 1987-88 for the purposes of conducting diagnostic and evaluation studies of current capabilities to compute energy and water budgets within or over the GCIP region, in concert with the Satellite Pathfinder studies

- GIDS-3: the GCIP Integrated Systems Test (GIST), scheduled for a three-month period sometime between 1 April and 30 September 1994 for the purpose of evaluating the capabilities of the existing observing networks, operational models, and data centers to support the GCIP Initial diagnostic, evaluation, and modeling studies as a buildup for the GCIP EOP. This test will utilize existing operational data and any other auxiliary data which could be provided by other programs (e.g., ARM and the Oklahoma mesonetwork). The GIST region is shown in Fig. 1. GCIP is considering providing augmented observations in the form of some added soundings and surface energy budget stations for a 5-7 year period at some of the sites composing the profiler hexagonal array that surrounds the CART site, as discussed in section 2.5.

The Enhanced Observation Period of GCIP would benefit from augmentation of the nation's observing capabilities during the latter part of this decade, with an increase in radiosonde data, support for the development of the Commercial Aircraft Sensing of Humidity (CASH) program, and the possible establishment of several radiation flux tower systems across the central U.S., 915 MHz wind profiler systems, and ground-based DIAL (Differential Absorption Lidar) systems along the southern rim of the U.S. to measure the low-level inflow of moisture into the GCIP continental region from the Gulf of Mexico. These and other supporting measurement systems for GCIP are depicted in Fig. 2.

2.3 GEWEX Cloud Systems Study (GCSS)

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The GEWEX Cloud Systems Study (GCSS) program seeks to improve the physical understanding of sub-grid scale cloud processes and their representation in parameterization schemes. By improving the description and understanding of key cloud

system processes, GCSS aims to develop the necessary parameterizations in climate and numerical weather prediction (NWP) models. GCSS will address these issues mainly through the development and use of cloud-resolving or cumulus ensemble models to generate realizations of a set of archetypal cloud systems. The focus of GCSS is on mesoscale cloud systems, including precipitating convectively-driven cloud systems like MCSs and boundary layer clouds, rather than individual clouds, and on their large-scale effects. Some of the key scientific issues confronting GCSS that particularly relate to research activities in the central U. S. include the need to:

- Produce a global climatology of MCSs and understanding of the role of mesoscale convectively-driven circulations in the global circulation.
- Produce new flux parameterizations for organized convection and a suitable closure for organized and mesoscale fluxes in global models.
- Understand the effects of the ice phase and radiative fluxes on MCS transports.
- Understand the effects of mesoscale processes on the coverage of boundary layer clouds and how to parameterize these relationships.
- Develop a suitable parameterization of cloud water content, entrainment rates, cloud radiative properties, and the influence of cloud condensation spectra on stratocumulus cloud microphysical and radiative properties.

Observations from field programs will be used to develop the cloud resolving models which, in turn, will be used as test beds to develop the parameterization schemes for the large-scale models. The cloud-resolving models provide synthetic data sets representing rather complete descriptions of entire cloud systems from which it will also be possible to develop algorithms for remote sensing observations. GCSS ultimately aims to develop the scientific basis for cloud process parameterization. New data sets that can adequately measure scale interactive aspects for comparison with the cloud-resolving model simulations need to be identified.

There are mutually supporting elements between GCSS and several of the other programs discussed in this report, as shown in Fig. 3. For example, the specific data requirements defined by the GCSS Science Team include the need (common with the objectives of the USWRP) for obtaining information on the large-scale forcing and mesoscale dynamical processes, which plays a controlling role in the generation and evolution of many cloud systems. GCSS also requires accurate determination of the profiles of the apparent sources of heat, moisture, and momentum throughout the atmosphere, information which would also go far in satisfying the GCIP need to understand the sources of error which accrue from attempting to determine water and energy budgets at the

continental scale. These profiles are most accurately obtainable on scales sampled by Doppler radars and research aircraft. The distribution of cloud properties in the grid volume, including the radiative flux profile and microphysical properties associated with the clouds, is also a GCSS requirement, a need which can perhaps best be met by coordinating with the ARM and GVaP measurement programs. Finally, GCSS requires information on the distribution of internal cloud properties (e.g., updrafts and downdrafts, mass fluxes, and microphysics), for which very detailed measurements will be needed. Thus, for the planned GCSS study of the MCS type of cloud system, it is essential that a multiscale experiment be performed. The plan is to have the GCSS working groups finalize the Implementation Plan, which is in draft form, by early 1994. A summary of the GCSS strategy is published in the Science Team Report (Betts et al. 1993).

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2.4 GEWEX Water Vapor Project (GVaP)

David Starr

The goal of the GEWEX Water Vapor Project (GVaP) is to improve the understanding of water vapor in meteorological, hydrological, and climatological processes through improving knowledge of water vapor and its variability on all scales. This goal clearly requires a multiscale observing strategy. A pilot project was deemed the most appropriate first step toward achieving this goal. An implementation plan has been developed for this pilot phase, which has four research components:

- The assessment of current capabilities to determine the global distribution of water vapor content using various spaceborne remote sensing instruments and algorithms through a rigorous comparison focused on the period July 1987-June 1989.
- Operation of a state-of-the-art, research quality, multisensor Water Vapor Reference Station at the ARM/CART site near Lamont, Oklahoma for a continuous period of 3 months in late spring of 1995 (which coordinates perfectly with the CME plans).
- Performance of a systematic, intensive intercomparison of as many of the available in situ and remote sensing water vapor sensors as possible during a 4-week episode within the 3 month operation period of the Water Vapor Reference Station.
- Initiation of research and development to define and fully characterize an optimum water vapor sensor and data processing system for use with operational radiosondes and to work toward international standardization with the World Meteorological Organization.

The GVaP Strategic Research Plan and the Pilot Phase Implementation Plan have both been published (Starr and Melfi 1991, 1992). The plans for the Water Vapor Reference Station instrumentation consist of adding a Raman lidar and three-hourly radiosonde